CLAIMS

1. A magnetic field detector having a reference magnetoresistive element and a magnetic field detecting magnetoresistive element, the reference magnetoresistive element and the magnetic field detecting magnetoresistive element each having a stack structure including:

an antiferromagnetic layer,

a first layer of a ferromagnetic material with the direction of magnetization fixed by the antiferromagnetic layer,

a nonmagnetic layer, and

a second layer of a ferromagnetic material with the direction of magnetization adapted to be changed by an external magnetic field,

characterized in that the reference magnetoresistive element is such that the direction of magnetization of the first layer and the direction of magnetization of the second layer in the nonmagnetic field are parallel or antiparallel to each other, and

the magnetic field detecting magnetoresistive element is such that the direction of magnetization of the first layer and the direction of magnetization of the second layer in the nonmagnetic field are different from each other.

2. The magnetic field detector as set forth in claim 1, characterized in that the direction of magnetization of the first layer of the reference magnetoresistive element and the direction of magnetization of the first layer of the magnetic field detecting magnetoresistive element are parallel or antiparallel to each other.

3. The magnetic field detector as set forth in claim 1, characterized in that the reference magnetoresistive element is magnetically shielded.

4. The magnetic field detector as set forth in claim 1, comprising a plurality of

reference magnetoresistive elements, characterized in that a first reference magnetoresistive element is such that the direction of magnetization of the first layer and the direction of magnetization of the second layer in the nonmagnetic field are parallel to each other, and a second reference magnetoresistive element is such that the direction of magnetization of the first layer and the direction of magnetization of the second layer in the nonmagnetic field are antiparallel to each other.

5. The magnetic field detector as set forth in claim 1, characterized by comprising a magnetic field application wire capable of applying a known magnetic field to the magnetic field detecting magnetoresistive element.

6. The magnetic field detector as set forth in claim 1, characterized in that the reference magnetoresistive element and the magnetic field detecting magnetoresistive element are formed on the same substrate.

7. The magnetic field detector as set forth in claim 1, comprising a magnetic field application wire capable of applying a known magnetic field and further comprising a saturated magnetic field detecting magnetoresistive element having the same external magnetic field response characteristic as the magnetic field detecting magnetoresistive element.

8. The magnetic field detector as set forth in claim 1, comprising:

a resistance-voltage conversion circuit for converting the resistance of the reference magnetoresistive element and the resistance of the magnetic field detecting magnetoresistive element into voltages; and

an add-subtract amplifier circuit for amplifying the difference between the voltages converted from the resistance of the reference magnetoresistive element and the resistance of the magnetic field detecting magnetoresistive element by the resistance-

voltage conversion circuit.

9. The magnetic field detector as set forth in claim 8, characterized by comprising a magnetic field application wire capable of applying a known magnetic field to the magnetic field detecting magnetoresistive element.

10. The magnetic field detector as set forth in claim 4, comprising:

a resistance-voltage conversion circuit for converting the resistance of a first reference magnetoresistive element, the resistance of a second reference magnetoresistive element and the resistance of the magnetic field detecting magnetoresistive element into voltages;

an add-subtract amplifier circuit for amplifying the difference between the voltages converted from the resistance of the first reference magnetoresistive element and the resistance of the magnetic field detecting magnetoresistive element by the resistance-voltage conversion circuit and the difference between the voltages converted from the resistance of the first reference magnetoresistive element and the resistance of the second reference magnetoresistive element by the resistance-voltage conversion circuit, and outputting first and second voltages, respectively; and

a multiply-divide circuit for outputting the division of the first voltage and the second voltage as a third voltage.

11. The magnetic field detector as set forth in claim 4, comprising:

a resistance-voltage conversion circuit including a third reference magnetoresistive element having the same external magnetic field response characteristic as the first reference magnetoresistive element for converting the resistance of the first reference magnetoresistive element, the resistance of the second reference magnetoresistive element, the resistance of the third reference magnetoresistive element and the resistance of the magnetic field detecting magnetoresistive element into voltages;

an add-subtract amplifier circuit for amplifying the difference between the voltages converted from the resistance of the first reference magnetoresistive element and the resistance of the magnetic field detecting magnetoresistive element by the resistance-voltage conversion circuit and the difference between the voltages converted from the resistance of the second reference magnetoresistive element and the resistance of the third reference magnetoresistive element by the resistance-voltage conversion circuit, and outputting first and second voltages, respectively; and

a multiply-divide circuit for outputting the division of the first voltage and the second voltage.

12. The magnetic field detector as set forth in claim 9, comprising:

a resistance-voltage conversion circuit including a magnetically-shielded calibration magnetoresistive element having the same external magnetic field response characteristic as the magnetic field detecting magnetoresistive element for converting the resistance of the first reference magnetoresistive element, the resistance of the second reference magnetoresistive element, the resistance of the magnetic field detecting magnetoresistive element and the resistance of the calibration magnetoresistive element into voltages;

a second add-subtract amplifier circuit for outputting, as a fourth voltage, the difference between the sum of the voltage converted from the resistance of the first reference magnetoresistive element and the voltage converted from the resistance of the second reference magnetoresistive element by the resistance-voltage conversion circuit on the one hand and a voltage twice as high as the voltage converted from the resistance of the calibration magnetoresistive element by the resistance-voltage conversion circuit on the other hand;

a second multiply-divide circuit for outputting the difference between the second voltage and the fourth voltage as a fifth voltage; and

a subtract circuit for outputting the difference between the third voltage and the

fifth voltage.

13. The magnetic field detector as set forth in claim 8, characterized in that the resistance-voltage conversion circuit, the add-subtract amplifier circuit and the multiply-divide circuit are arranged on the same substrate.

14. The magnetic field detector as set forth in claim 8, characterized in that the resistance-voltage conversion circuit includes a constant current source, a resistor and a magnetoresistive element.

15. The magnetic field detector as set forth in claim 11, characterized in that the resistance-voltage conversion circuit includes a constant voltage source, a resistor and a magnetoresistive element.

16. A current detection device using the magnetic field detector as set forth in claim 1.

17. A position detection device using the magnetic field detector as set forth in claim 1.

18. A rotation detection device using the magnetic field detector as set forth in claim 1.